

What is claimed is:

1. A method for forming an epi-channel of a p-channel metal-oxide-semiconductor (pMOS) device, comprising the
5 steps of:

forming a channel doping layer beneath a surface of a semiconductor substrate through a dual doping of dopants having different diffusion rates;

10 performing an annealing process for activating the dopants ion-implanted into the channel doping layer;

performing a surface treatment for removing a native oxide layer formed on a surface of the channel doping layer; and

15 growing a silicon epi-layer on the channel doping layer through a selective epitaxial growth.

2. The method as recited in claim 1, wherein the step of forming the channel doping layer includes further the steps of:

20 ion-implanting a first n-type dopant; and

ion-implanting a second n-type dopant having a diffusion rate higher than that of the first n-type dopant.

25 3. The method as recited in claim 2, wherein the first n-type dopant is As or Sb and the second n-type dopant is P.

4. The method as recited in claim 1, wherein the step of performing the annealing process is selected from either a rapid thermal annealing (RTA) or a spike RTA (SRTA).

5 5. The method as recited in claim 4, wherein the RTA is proceeded at a temperature ranging from about 600 °C to about 1050 °C, and the SRTA is performed at a temperature ranging from about 600 °C to about 1150 °C.

10 6. The method as recited in claim 1, wherein the surface treatment is performed at an atmosphere of hydrogen.

7. A method for fabricating a pMOS device, comprising the steps of:

15 forming an n-type channel doping layer beneath a surface of a semiconductor substrate through a dual doping of dopants having different diffusion rates;

20 performing a surface treatment for removing a native oxide layer formed on a surface of the n-type channel doping layer;

growing a silicon epi-layer on the n-type channel doping layer through a selective epitaxial growth;

25 forming sequentially a gate insulating layer and a gate electrode on a predetermined region of the silicon epi-layer through deposition and patterning processes;

forming a highly concentrated p-type source/drain extension region in a predetermined portion of the

semiconductor substrate beneath lateral sides of the gate electrode;

forming a spacer at lateral sides of the gate electrode; and

5 forming a highly concentrated p-type source/drain region electrically connected to the source/drain extension region.

8. The method as recited in claim 7, wherein the step
10 of forming the n-type channel doping layer includes further the steps of:

ion-implanting a first n-type dopant; and

ion-implanting a second n-type dopant having a diffusion rate higher than that of the first n-type dopant.

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9. The method as recited in claim 8, wherein the first n-type dopant is As or Sb, and the second n-type dopant is P.

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10. The method as recited in claim 7, wherein the annealing process is selected any one from a rapid thermal process (RTA) and a spike RTA (SRTA).

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11. The method as recited in claim 10, wherein the RTA is proceeded at a temperature ranging from about 600 °C to about 1050 °C, and the SRTA is performed at a temperature ranging from about 600 °C to about 1150 °C.

12. The method as recited in claim 7, wherein the surface treatment is carried out at an atmosphere of hydrogen.

5 13. The method as recited in claim 7, further comprising the step of forming an elevated source/drain region on the p-type source/drain region through a selective epitaxial growth.

10 14. A pMOS device, comprising:
 a semiconductor substrate;
 a channel doping layer being formed in a surface of the semiconductor substrate and being dually doped with dopants having different diffusion rates;
15 a silicon epi-layer being formed on the channel doping layer, whereby constructing an epi-channel along with the channel doping layer;
 a gate insulating layer formed on the silicon epi-layer;
20 a gate electrode formed on the gate insulating layer;
 a source/drain extension region highly concentrated and formed in the semiconductor substrate of both lateral sides of the epi-channel; and
 a source/drain region electrically connected to the source/drain extension region and deeper than the source/drain region.

15. The pMOS device as recited in claim 14, the channel doping layer is dually doped with the first n-type dopant and the second n-type dopant having a higher diffusion rate than that of the first n-type dopant.

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16. The pMOS device as recited in claim 15, wherein the first n-type dopant is As or Sb, and the second n-type dopant is P.

10 17. The pMOS device as recited in claim 14, wherein the channel doping layer is formed to have a thickness ranging from about 10 nm to about 50 nm.

18. The pMOS device as recited in claim 14, the
15 silicon epi-layer is formed to have a thickness ranging from about 5 nm to about 30 nm.